QUALITATIVE COMPARISON OF THE QUALITIES OF PATENTS OUT OF IP5 COUNTRIES

By

JE, Seungho

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

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Committee in charge:

Professor Hun Joo PARK, Supervisor

Professor Sanghoon AHN

Professor Junesoo LEE

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ABSTRACT

COMPARISON OF THE QUALITIES OF PATENTS FROM IP5 COUNTRIES

By

Seungho JE

The quality of a patent is an important concept for estimating economic value of the patent and for identifying the integrity of the patent as well. This thesis compares the quality of patents out of the IP(Intellectual Property)5 countries with the world's top five patent offices(Korean Intellectual Property Office(KIPO), United States Patent and Trademark Office(USPTO), European Patent Office(EPO), Japanese Patent Office(JPO), State Intellectual Property Office(SIPO) of China) by analyzing international applications under the Patent Cooperation Treaty(PCT) which have been filed by IP5 countries and also that have been examined by the KIPO at the national phase of the PCT. With this empirical research, we can get to understand the qualities of patents of IP5 countries in a comparative way. This research will be useful to patent experts and economic experts interested in patents as well for identifying the factors affecting the qualities of patents and their applications.

ACKNOWLEDGEMENTS

It was my big pleasure to study at this prestigious school located in a newly-established Sejong City, even though it was a big challenge to study as a part-time student while working in the daytime.

While attending classes in the evening of midweeks or on weekends, I have been greatly fascinated by prestigious and ardent professors' lectures, and also have had very productive time with enthusiastic fellow students with diverse disciplinary backgrounds and foreign students worldwide as well.

In retrospect, I could not have published this work within the limited period of time, without my professors' careful and attentive supervision. I would like to deliver my deepest gratitude to Professor Hun-Joo Park, and Professor Sanghoon Ahn.

I also owe my family – my wife and two young sons - who has supported me all the way. I would like to give an immeasurable gratitude to my family as I was indulged in this study.

I hope that this study can make a contribution to make many people understand what it means by the quality of a patent from a common-sense perspective.

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LIST OF ABBREVIATIONS

CN: China

CPC: Cooperative Patent Classification

EP: Europe

EPO: European Patent Office

IPER: International Preliminary Examination Report

IP5patent offices: Intellectual Property five patent offices

IPTAB: Intellectual Property Trial and Appeal Board

ISA: International Search Authority

ISR: International Search Report

JP: Japan

JPO: Japanese Patent Office

KIPO : Korean Intellectual Property Office

KR: Korea

PCT: Patent Cooperation Treaty

SIPO: State Intellectual Property Office of China

US: United States of America(USA)

USPTO: United States Patent and Trademark Office

WIPO: World Intellectual Property Office

Chapter Ⅰ – Introduction

People tend to think that a patent has a high economic value and that multiple patents are more economically valuable than just one. That may be largely right, but not all the time. One of the important reasons is that “a patent is one thing and a market, where the economic value of a patent is decided, is another”. For the patent to be economically valuable, it should carry a definite scope of technological innovation included in a product exactly, because the economic value of a patent is related to the technological innovation and tends to be influenced by a market selection. That’s why the economic value of a patent is relatively difficult to estimate.

Another issue that can be raised regarding a patent is the quality of a patent. The quality of a patent is a broad but also important concept for identifying the economic value of a patent. For a patent to be economically valuable, it should be unconditionally of high quality. However, even when a patent is not economically valuable, the patent can be of high quality.

This thesis aims to compare the qualities of patents which have come from the IP(Intellectual Property)5 countries with the world’s top five patent offices(Korean Intellectual Property Office(KIPO: KR), United States Patent and Trademark Office(USPTO: US), European Patent Office(EPO: EP), Japanese Patent Office(JPO: JP), State Intellectual Property Office(SIPO: CN)

of China) by analyzing their respective international applications filed under the Patent Cooperation Treaty (PCT) for ten years to provide empirical and practical information about the present level of the qualities of patents of the IP5 countries.

1. Outline of a patent[1] system

A patent (right), a kind of intellectual property right[2], is usually defined as a set of exclusive rights granted by a sovereign state to an inventor or assignee for a given period of time – usually for twenty years - in exchange for detailed public disclosure of the patented invention. An invention is a solution to a specific technological problem and can also be a product, a process or a method of making the product.

A patent (right) is granted to a patent applicant when it is found that relevant patentability requirements such as industrial applicability, novelty, and non-obviousness (or inventive step) are met through the examination procedure by the corresponding authority of the sovereign state according to its patent law. A patent must include more than one claim that define the invention(s) having a

[1] http://www.wipo.int/patents/en/

[2] Intellectual property right as a kind of intangible right includes patent (right), utility model (right), trademark (right), industrial design (right), geographical indication (right), copyright, etc.

mutually unitary technological subject matter. Each invention claimed in the patent defines a technological intellectual property right. A patent (right) gives the patentee the right to prevent, or at least to try to prevent, others from commercially making, using, selling, importing, or distributing the patented invention(s) without the patentee's permission.

2. World Intellectual Property Office(WIPO)[3] and Patent Cooperation Treaty(PCT)[4]

The WIPO is one of the specialized agencies of the United Nations, founded in 1967 to promote protection of the intellectual properties including patent, trademark, industrial design, copyright, etc. throughout the world. It also has 189 member states, and administers 26 international treaties including the PCT.

The PCT is an international patent law treaty, concluded in 1970. It provides a unified procedure for filing patent applications to protect the inventions that the applications cover in each of its contracting states. A patent application filed under the PCT is called an international application, or PCT application. A single filing of a PCT application is required to be made with one of the Receiving Offices in one language. A prior art search regarding the claimed

[3] http://www.wipo.int/about-wipo/en/

[4] http://www.wipo.int/pct/en/

invention is then performed by the International Search Authority(ISA), and a written opinion regarding the patentability of the invention is issued. It can optionally be followed by a preliminary examination, performed by an International Preliminary Examining Authority(IPEA). Eventually, the relevant national or regional authorities administer the substantive examination of the application and the issuance of the patent. A PCT application, which establishes a filing date in all contracting states, must be entered into a national or regional phase to proceed towards the grant of one or more patents, because the grant of a patent is a unique prerogative of each national or regional authority.

3. Intellectual Property five(IP5)[5]

An Intellectual Property five(IP5) is a term for the five largest intellectual property offices in the world (especially in the context of discussing harmonization of patent laws): the Korean Intellectual Property Office(KIPO), the United States Patent and Trademark Office(USPTO), the European Patent Office(EPO)[6], the Japan Patent Office(JPO), and the State Intellectual Property

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5 http://www.kipo.go.kr/kpo/user.tdf?a=user.english.html.HtmlApp&c=100015&catmenu=ek02_02_02

6 European consolidated intellectual property office called EPO under the EPC (European Patent Convention) signed on October 1973. There are 38 member states including Germany, United Kingdom, and France under the EPC.

Office(SIPO) of China.

Chapter Ⅱ – Literature review

1. Definition of a patent

A patent is defined as a set of exclusive rights granted by a sovereign state to an inventor or assignee for a limited period of time in exchange for detailed public disclosure of an invention in a written language, as we explained in the preceding chapter.

A patent application is accompanied by the title of the invention, the specification of the invention, (patent) claims and its related drawings according to the Patent Act of Korea §42. A patent examiner examines each patent application to decide whether the application is patentable or not by checking the patentability of the claimed invention(s), the compliance of description requirements of the claims and the specifications attached to the application. If the patent application is found to have failed to meet the patentability or the description requirement, it is rejected.

2. Definition of the quality of a patent

The quality of a patent can be defined in various ways. It’s often defined as whether the legal requirements like the appropriate subject matter, utility,

disclosure, enablement, novelty and non-obviousness are properly met[7], or the extent to which a granted patent meets or exceeds the statutory standards of patentability, which is novelty, non-obviousness, and the clearly written document with sufficient disclosure[89]. SONG Hefa defines the patent quality as the degree of a patent application or granted patent meeting the statutory requirements of patentability, and the degree of its specification meeting requirements of sufficient disclosure[10]. The definition can be understood in two related aspects: One is from patentability. It refers to novelty, inventiveness, and practical applicability, which are the universal standards for a patent. The degree of meeting these standards reflects whether the patent quality is high or low. The other is from legal stability and the purpose of patent system, which is a temporary monopoly given in return for the sacrifice of disclosing technological information to promote further innovation[11]. Based on the definition above, the content of patent quality is divided into three different but

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[7] SCOTCHMER, S. 2004.『Patent Quality, Patent Design, and Patent Politics: Remarks before the European Patent Office as a member of the Advisory Group, European Patent Office』, Munich, p.10.

[8] R. POLK WAGNER, op. cit. p.4.

[9] GRAF, S. W. 2007.『Improving patent quality through identification of relevant prior art: approaches to increase information flow to the patent office』, *Lewis & Clark L. Rev.*, 11, p.495.

[10] SONG HEFA, M. R., CHEN FANG 2010,『Patent quality and its measurement method』, *Sciecnce of Scicence and Management of S&T,* 31, pp.21-27.

[11] SONG Hefa1, LI Zhenxing, op. cit. p.4.

related aspects: technological quality, legal quality and commercial quality[12]. SONG Hefa1 and LI Zhenxing divided indicators of patent quality into four dimensions for measurement, including quality of invention, quality of application document, quality of examination and quality of commercialization, which covers the technological, legal and commercial aspects[13].

Although there can be various definitions for the quality of a patent as we see in the above, the quality can be said to be defined as a kind of tool for measuring how strong a patent is as to survive from validity challenges from the 3rd parties and about how appropriate, clear, useful or valuable it is as to confront as many persons with unintentional patent infringement as possible.

3. Why is the quality of a patent important?

A patent is an intangible property right. It should be of no defects and should have a high possibility of using the right. People therefore want to know which patent is of high quality and how the quality of a patent can be measured.

Sometimes just one patent can be worth more than one hundred patents. A patent of good quality might create huge amounts of economic value in a form of royalty when the relevant market opens. It can also help protect our

[12] SONG Hefa1, LI Zhenxing, op.cit. pp.4-5.

[13] SONG Hefa1, LI Zhenxing, op. cit. p.7.

manufacturing businesses from the outside legally. So, it is not so important to have as many patents but to have a patent of good quality.

A patent may also be subject to transaction or license as a property right. In making transaction or license agreements, proper evaluation of the patent is necessary. One of the important steps for evaluating a patent is measuring the quality of a patent. Therefore, people need a useful concept like 'the quality of a patent' for identifying a patent of high quality.

4. Related prior research

Regarding the quality of a patent[14]

There have existed various ways of defining of the quality of a patent or a patent quality

R. Polk Wagner has said that a patent quality is considered to be the capacity of a granted patent to meet (or exceed) the statutory standards of patentability—most importantly, to be novel (35 U.S.C §102), non-obvious (35 U.S.C. §103),

[14] Many prior researches use 'patent quality' or 'patent qualities' instead of 'the quality of a patent' or 'the qualities of patents' respectively. This thesis will use 'the quality of a patent', 'the qualities of patents' except for quoting prior researches using 'patent quality' or 'patent qualities'.

and to be clearly and sufficiently claimed and described (35 U.S.C. §112)[15].

Christi J. Guerrini has proposed that the features or dimensions of patent quality include (1) a patent's probable validity; (2) clarity of the patent; (3) faithfulness of the patent to the scope of the underlying invention; (4) social utility of the invention; and (5) commercial success of the invention[16].

Mariagrazia Squicciarini suggested three alternative definitions of the experimental patent quality indicator in order to better see the impact of the grant lag index and the backward citations index on the indicator. The first one includes 4 components (the number of forward citations (up to 5 years after publication); patent family size; the number of claims; and the patent generality index), the second one also has 4 components (the number of forward citations (up to 5 years after publication); patent family size; corrected claims; and the patent generality index), and the last one includes 6 components (the same components as above, plus the number of backward citations and the grant lag index)[17].

Jean O. Lanjouw and Mark Schankerman constructed a minimum-variance

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[15] R. POLK WAGNER,『UNDERSTANDING PATENT QUALITY MECHANISMS』, University of Pennsylvania Law School, 2009, p.4.

[16] Christi J. Guerrini,『2014 Defining Patent Quality』, Fordham Law Review, Vol. 82, Issue 6, IIT Chicago-Kent College of Law, p.37.

[17] Mariagrazia Squicciarini,『Measuring Patent Quality』, OECD Science, Technology and Industry Working Papers 2013/03, p.59.

index based on four patent characteristics – the numbers of claims, forward citations, backward citations, and patent family size in developing an index of patent quality in the middle of introducing three factors (the level of demand, the quality of patents and technological exhaustion) for the determinants of research productivity (the patent / R&D ratio)[18].

Giuseppe Scellato proposed three different options to assess the quality of a patent: optimal balance between scope and legal certainty, clear disclosure, and high inventive step[19].

SONG Hefa and Li Zhenxing have said that the patent quality can be measured from four aspects: quality for invention, quality for application document, quality under examination, and quality for commercialization[20].

In sum, prior researches state that the quality of a patent is affected by the statutory requirement of patentability(△novelty, △non-obviousness (high inventive step), △clarity and validity of a patent), the scope of a patent(△the

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[18] Jean O. Lanjouw and Mark Schankerman, 『PATENT QUALITY AND RESEARCH PRODUCTIVITY: MEASURING INNOVATION WITH MULTIPLE INDICATORS』, Royal Economic Society 2004, p.24.

[19] Giuseppe Scellato et al., 『Study on the quality of the patent system in Europe』, Tender MARKT/2009/11/D Contract Notice in the Official Journal of the European Union 2009/S 147-214675 of 04/08/2009, 2011, pp.8-9.

[20] SONG Hefa1, LI Zhenxing, 『Patent quality and the measuring indicator system: Comparison among China provinces and key countries』, Institute of Policy and Management, Chinese Academy of Sciences, 2014, p.1.

number of claims, △patent family size), and the utility of a patent(△commercial success of a patented invention, △forward citations and backward citations).

What causes low quality of a patent?

There are some possible reasons why the low quality of a patent occurs.

First, patent applicants or patentees try to have their claimed inventions with a broad scope in order to exercise strong patent rights over any third parties. However, chances are that the inventions would rather become abstract, vague or unclear, in so doing.

Second, a lot of manufacturers have sought quantity-driven patent application filing policies for a long time. That's why they have come to think highly of quantity rather than quality with respect to patent applications.

Third, most big manufacturers have also been filing defensive patent applications for the purpose of protecting their businesses. Once they disclose their own technologies to the public by filing patent applications before their competitive companies entered the markets, they can protect their businesses from their potential competitors.

Fourth, the retainer paid by clients to patent attorneys for filing a patent

application in Korea has not changed greatly for the last decade. It means most patent attorneys hardly have reasonable incentives to undertake sincere proxy tasks for drawing patent authority's official determinations to grant patent rights to their clients(patent applicants).

Fifth, when the monthly workload of each patent examiner in the KIPO is heavy, the patent examiner has a limitation in thoroughly reviewing each patent application filed. Especially, for the case of KIPO patent examiners, their workloads have been heavy. In other words, each KIPO patent examiner has examined about forty patent applications a month in average, which is a two to three times heavier workload than in other IP5 countries, under the general goal of providing world's fastest patent examination services to patent applicants around the world.

Chapter Ⅲ – Research Method and Data

1. Possible indicators of the quality of a patent

This thesis tries to see the qualities of patents irrespective of their technological fields. Especially, the commercial success is very difficult to correlate with the corresponding patents during the analysis, which is the regime of complicated legal analysis of the patents.

There are two types of technology in terms of substitutable characteristics: a substitutive technology and a complementary technology. If a patented invention is about a complementary technology, chances are the patent will succeed in the market. But in the case of a substitutive technology patent, the patent should compete in the market for commercial survival, which is much tougher. However, most technologies have both characteristics in reality. So, this thesis will briefly deal with the quality of a patented invention, but mainly treat the quality of statutory requirement, e.g. △ meeting statutory standards of patentability (industrial utility, novelty and non-obviousness), and △ enablement, clearness, logicality, and disclosure requirements of the specification.

The economic value of a patented invention

An economic value of a patented invention is about how useful or valuable it is. When it is about original, high-efficient, breakthrough or standard-essential invention, it can be said that the economic value of the patented invention is high. It is closely related to the contents of the patented technology.

Patent Grant Ratio

A patent grant ratio is the ratio of the number of the patents granted out of the entire patent applications through the examination procedure of the IP5 patent offices(KIPO, USPTO, EPO, JPO, SIPO). The ratio is a good indicator for measuring and comparing the qualities of patents out of IP5 countries. It can be said that “the higher the ratio is, the higher the quality is”.

The scope of a patent right

A scope of a patent right is defined by its patent claims. So the scope of a patent right is closely related to the quality of a patent. The bigger the average number of claimed inventions in an application is or the smaller the minimum number of components of each claimed invention is, the wider the scope of the patent is.

The volume of the specification (the number of pages of the specification)

The volume of the specification is related with the quality of a patent to some degree, considering that a patent applicant usually pays fee in proportion to the volume of the specification[21]. The number of pages of the specification in a standard form can stand for how the invention is technologically complicated.

Potential social utility and commercial success

If the patented invention is thought to achieve social utility and commercial success in the future or if it has already succeeded commercially in the market, it can be said that the patent is of high quality.

Patent Family Size

A patent family size is defined as the number of the designated states in a patent application under the PCT. The PCT application will enter the national stage at the designated states, after getting through pertinent procedures of the

[21] It assumes that the patent applicant does not intentionally increase the volume of the specification in the patent application at least.

international stage. So, a patent family size functions to mean how extensively a patent-pending or possibly patented invention can be used around the world. So it is believed to be proportionate to the quality of a patent.

Retrieval Quality

A retrieval quality is about the patentability of a patent application disclosed through a preliminary prior art search by the ISA during the international stage. A prior art document that can reject the patent application is marked with the alphabet X or Y in the ISR. If X- or Y-marked documents are found, the retrieval quality is deemed high. An X-marked document by itself is believed to be a good evidence for rejecting the patent application, while a Y-marked document can be a good evidence for rejecting the patent application only when it is combined with other influential evidence. Besides X- or Y- documents, there are A-marked documents that are just relevant to the claimed inventions, but that cannot reject them.

The number of technical documents cited in the specification

When two documents are linked together in this way, both can be alternately

referred to as the "citation" depending upon one's point of view. The terms used to clarify the relationship are "backward citation" and "forward citation." A "backward citation" is the term used for a traditional citation: it is a document that was published earlier, and which appears on a newer document's front page. In turn, the newer document is called the "forward citation" or "citing document." For example, if a patent 'A' is cited by a patent 'B', then the patent 'A' is a backward citation of the patent 'B' and the patent 'B' is a forward citation of the patent 'A'.

Obviously, forward citations cannot appear on a document's front page, since no one can see the future, and patents are published at the time of issuance.

Patent Abandonment Ratio

A patent abandonment ratio is the ratio of willful terminations before the expiration of the terms of the patent rights. Once a patent right is granted through patent examination procedure, the patent right is given to the patentee for twenty years reckoned from the time when the patent application is filed since the filing date of the patent application. Instead, the patentee should pay renewal fees every three years to maintain the patent right up to the expiration day of the patent application. If a patentee don't renew his patent right, it can be assumed that he thinks it is worthless to renew the patent right. In contrast,

fulfilling the term of the patent right up to twenty years reckoned from the filing date of the patent application means that it is worthy of maintaining. So the bigger the ratio is, the lower the quality of a patent is.

The ratio of patent invalidation

The ratio of patent invalidation is a measurement about how strong a patent is enough to survive when an invalidation trial is raised by a third party. Any third party can raise a patent invalidation trial against the patentee at the Intellectual Property Trial and Appeal Board(IPTAB). Then the IPTAB decides whether the patent deserves invalidation or not. So the higher the ratio of patent invalidation is, the lower the quality of a patent is.

The ratio of patent infringement

The ratio of patent infringement is a measurement about how useful a patent is as to cause a third party to inevitably use the patent in doing its business. The patentee can raise a patent infringement trial against the third party for arguably having infringed his patent before the IPTAB. Then the IPTAB decides whether the third party has indeed infringed the patent or not. So the higher the ratio of patent infringement is, the higher the quality of a patent is.

The number of exclusive rights, non-exclusive rights, and pledge rights established on the patents

If a patentee does not use his patent by himself, he can make a third party to use the patent by establishing an exclusive right or a non-exclusive right on the patent. The patentee can loan money from a bank on security for the patent by establishing a pledge right on the patent. When such rights are established on a patent, it is usually thought that the patent is useful and highly qualitative. So the bigger the number of exclusive rights, non-exclusive rights and pledge rights established on the patents, the higher the quality of a patent is.

2. Choosing Analysis Object Range (PCT patent applications)

Totally 309,445 PCT patent applications for patents entering into Korea for a national stage over the past ten years from 2006 to 2015 are the object for analysis of this thesis. Most of the applications were filed at least one year before entering into a national phase. The relevant atypical statistical data has sourced directly from the KIPO in August 2016.

3. Choosing applicable and effective factors for the analysis

The factors that affect the quality of a patent can be divided into two classes. The first class is a plus(+) factor, and the other one is a minus(-) factor. For the plus factors, this thesis chooses △a patent grant ratio, △The average number of claimed inventions in an application, and △the number of exclusive rights, non-exclusive rights and pledge rights established on the patents. In the meanwhile, it chooses △a patent abandonment ratio, △the ratio of X- or Y-marked documents in the ISR, and △the ratio of patent invalidation for the minus factors.

Chapter Ⅳ – Analysis and Findings

1. The analysis of the statistical data

The number of patent applications is not closely related to the quality of the patents. However it is possible to analyze 309,445 PCT patent applications filed from IP5 countries and compare them to see the qualities of patents in this case. So it is useful to review briefly the trend of the patent applications for the last ten years.

US, JP, and EP have been maintaining the number of PCT patent applications to about 10,000 every year. In the meanwhile CN and KR have been increasing PCT patent applications up to over 1,500 and over 800 respectively, while maintaining comparatively small average number of PCT patent applications every year – 671 and 514 respectively. However, the total number of PCT patent applications filed from IP5 countries has continued to increase. Especially CN has increased PCT patent applications in a large number.

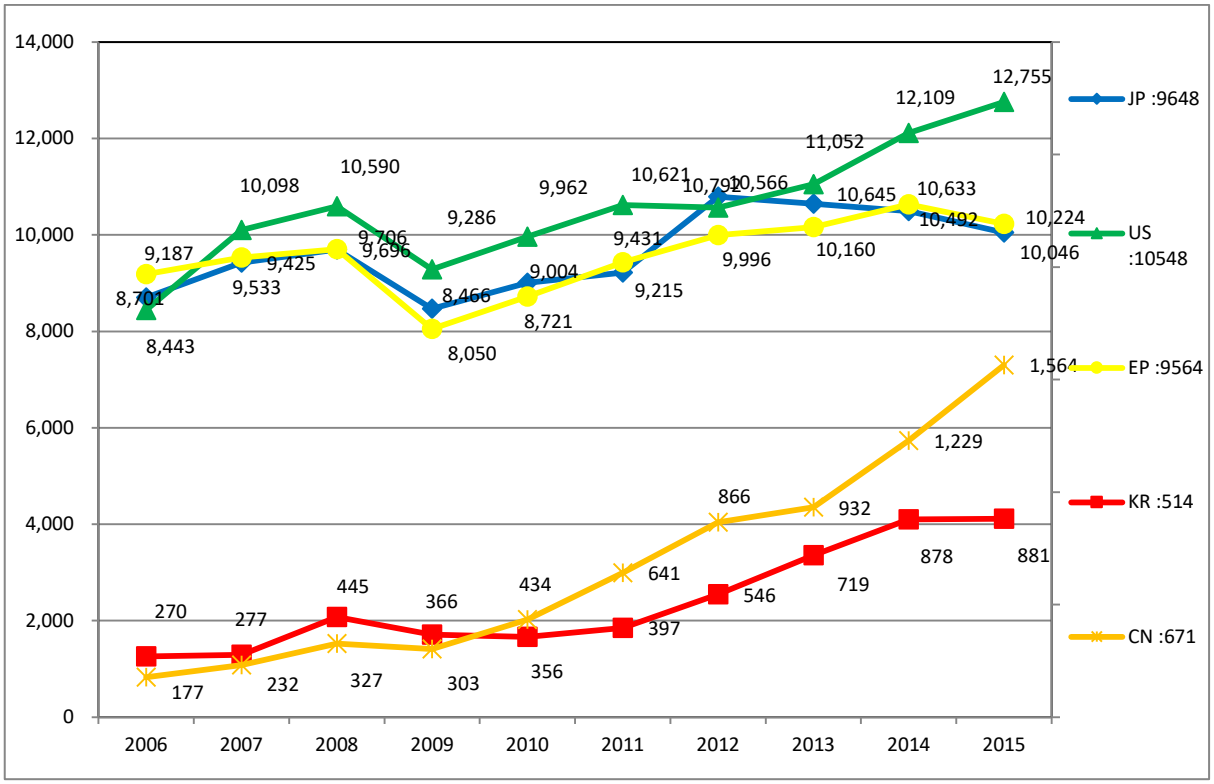

Figure 1. The number of PCT patent applications

A patent can be granted only if the patent application meets statutory requirement through patent examination. The statutory requirement consists of patentability requirement and enablement/clearness/disclosure requirement. A patentability requirement like industrial utility, novelty and non-obviousness is treated as a primary statutory requirement, and then patent examiners check if the disclosed invention of the PCT patent application is implementable from the perspective of a person of ordinary skills in the corresponding technical field and if the specification/description is clearly written. So, the patent grant ratio is one of the basic indicators for identifying the quality of a patent in the initial

stage of analysis. The patent grant ratio has been high in a descending order of KR(average 74% every year during the period), CN(〃 69% 〃), JP(〃 67% 〃), US(〃 54% 〃) and EP(〃 48% 〃).

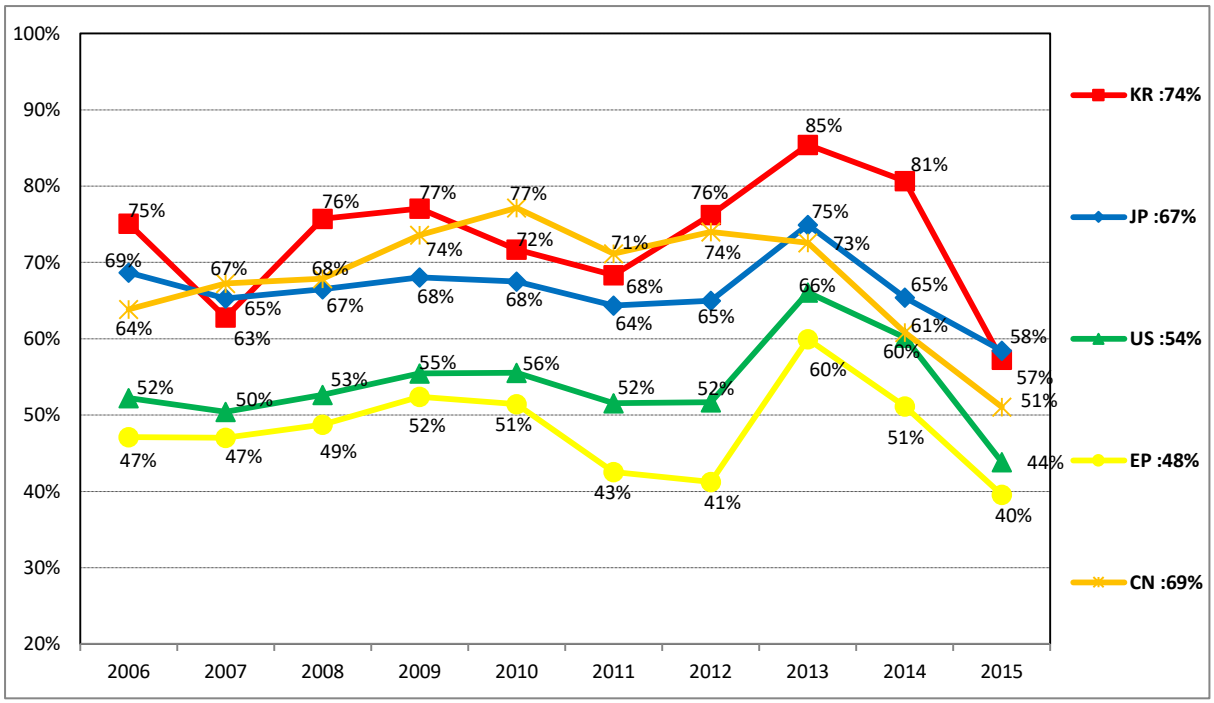

Figure 2. Patent Grant Ratio

There have been numerous PCT patent applications in a descending order of electricity(H section: average 8,472 patent applications every year during the period), chemistry/metallurgy(C section: 〃 7,271 〃), physics(G section: 〃 4,967 〃), human necessities(A section: 〃 3,840 〃), performing

operations/transporting(B section: 〃 3,678 〃), mechanical engineering/lighting /heating/weapons(F section: 〃 1,924 〃), textiles & paper(D section: 〃 336 〃), and fixed construction(E section: 〃 315 〃) according to the Cooperative Patent Classification(CPC).

Table 1. The CPC technological sections

A: Human Necessities
B: Performing Operations; Transporting
C: Chemistry; Metallurgy
D: Textiles; Paper
E: Fixed Constructions
F: Mechanical Engineering; Lighting; Heating; Weapons; Blasting
G: Physics
H: Electricity

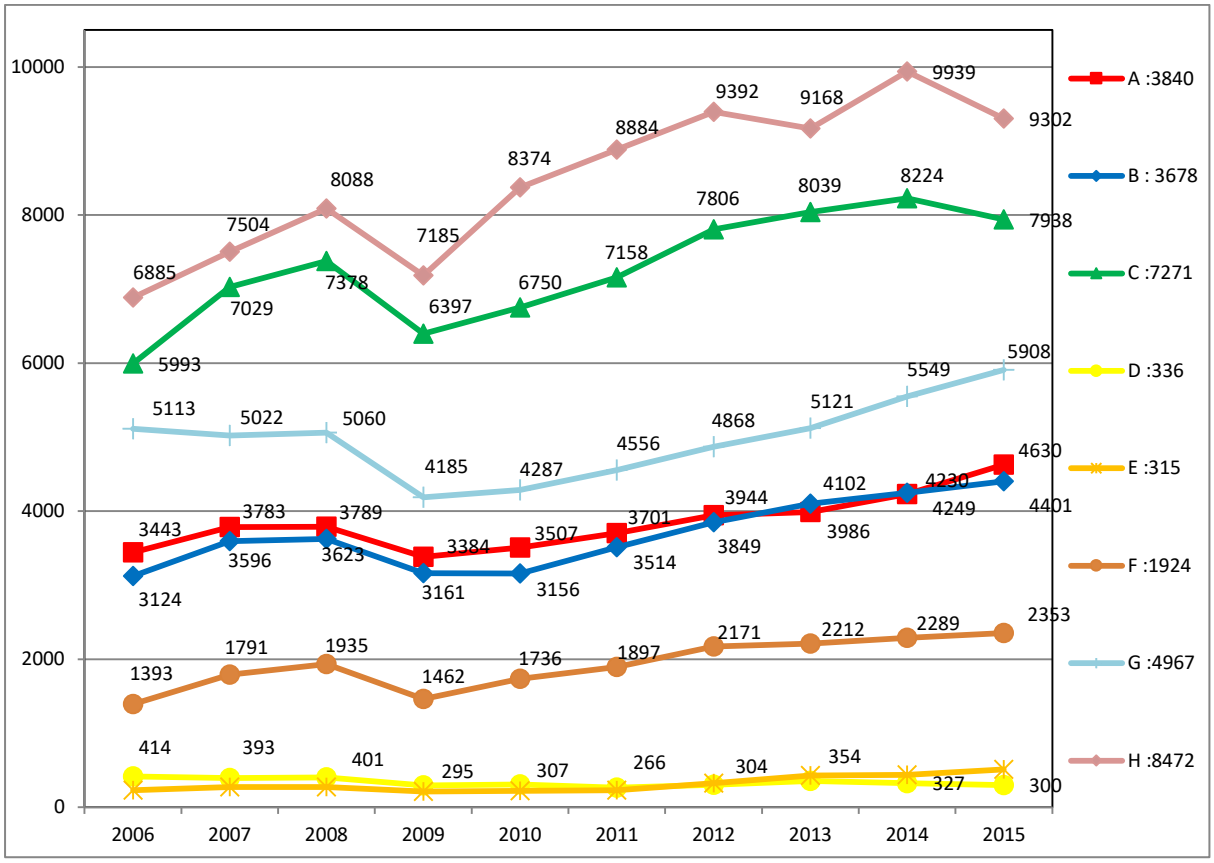

Figure 3. The number of PCT patent applications by CPC technological section

There has been high patent grant ratio in a descending order of electricity(H section; average 66% every year during the period), textiles/paper(D section; 〃 63% 〃), performing operations/transporting(B section; 〃 60% 〃), mechanical engineering/lighting/heating/weapons(F section; 〃 59% 〃), physics(G section; 〃 58% 〃), fixed construction(E section; 〃 58% 〃), chemistry/metallurgy(C section; 〃 52% 〃), and human necessities(A section;

〃 45% 〃).

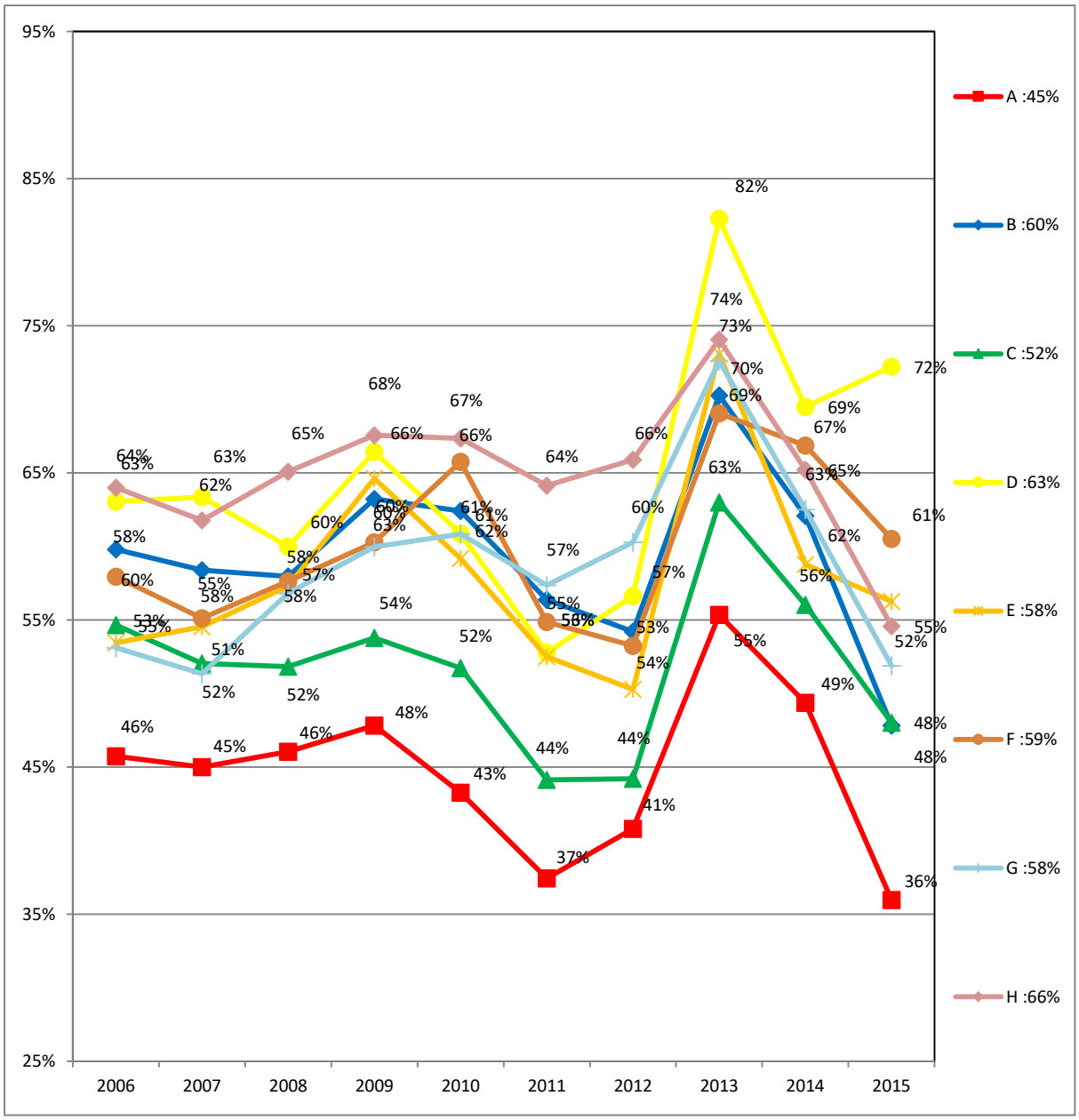

Figure 4. Patent Grant Ratio by CPC technological section

The number of the terminated patent rights before the expiration of the terms of the patent rights has been bigger in a descending order of JP (totally 5,069

during the period), US (3,026 〃), EP (2,208 〃), KR (100 〃) and CN (89 〃).

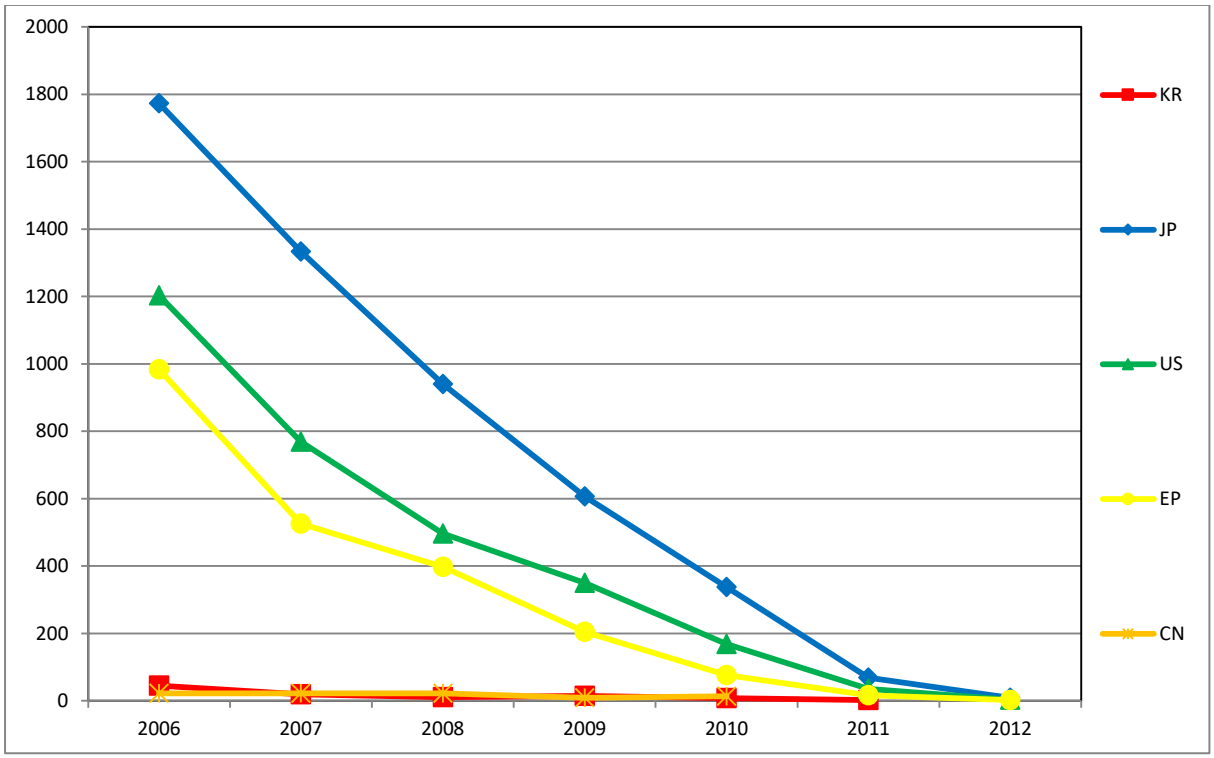

Figure 5. The number of terminated patent rights before the expiration of the terms of patent rights

The patent abandonment ratio, which represents the ratio of terminations before the expiration of the terms of the patent rights, has been bigger in a descending order of JP (average 10% every year during the period), US(〃 8% 〃), CN(〃 7% 〃), EP(〃 4% 〃) and KR(〃 3% 〃).

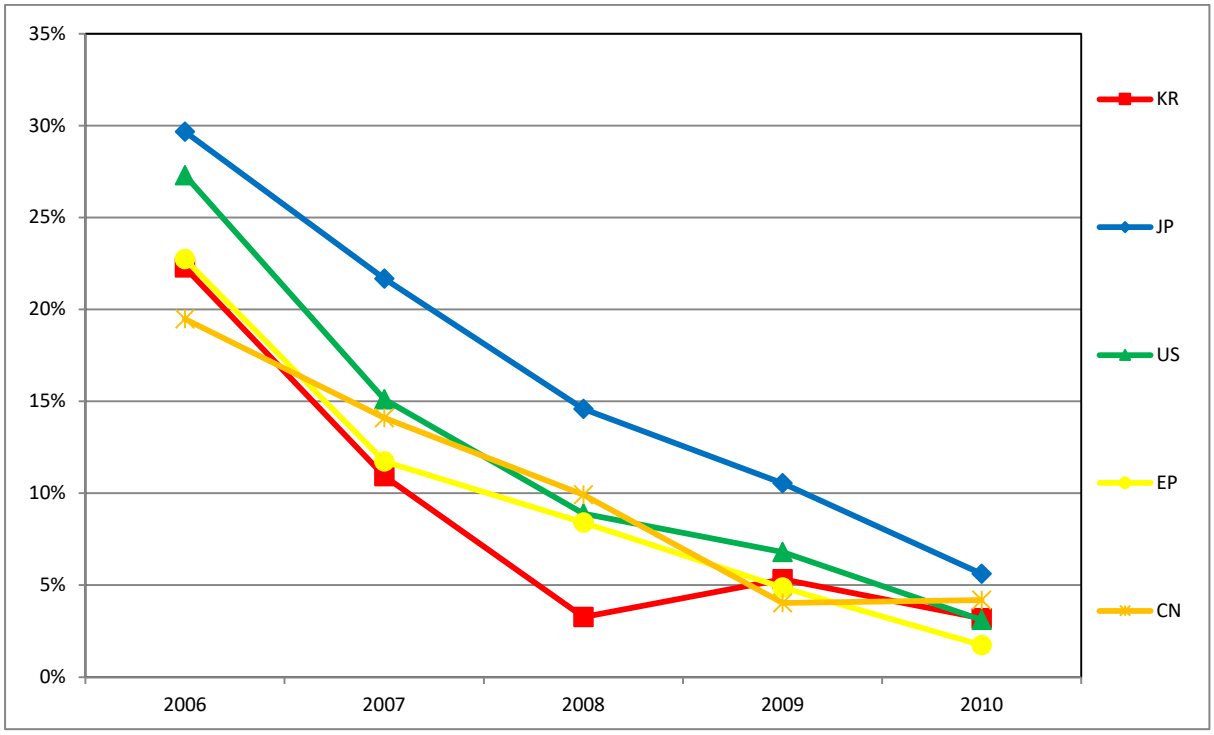

Figure 6. Patent Abandonment Ratio

The average number of claimed inventions in an application has been bigger in a descending order of US (average 24 during the period), EP (〃 17 〃), KR (〃 15 〃), CN (〃 14 〃) and JP (〃 11 〃). So it can be said that US and EP are more willing to pay expenses to get concrete patent rights than CN and JP. The average number of claimed inventions in an application is not so strongly related with the quality of a patent.

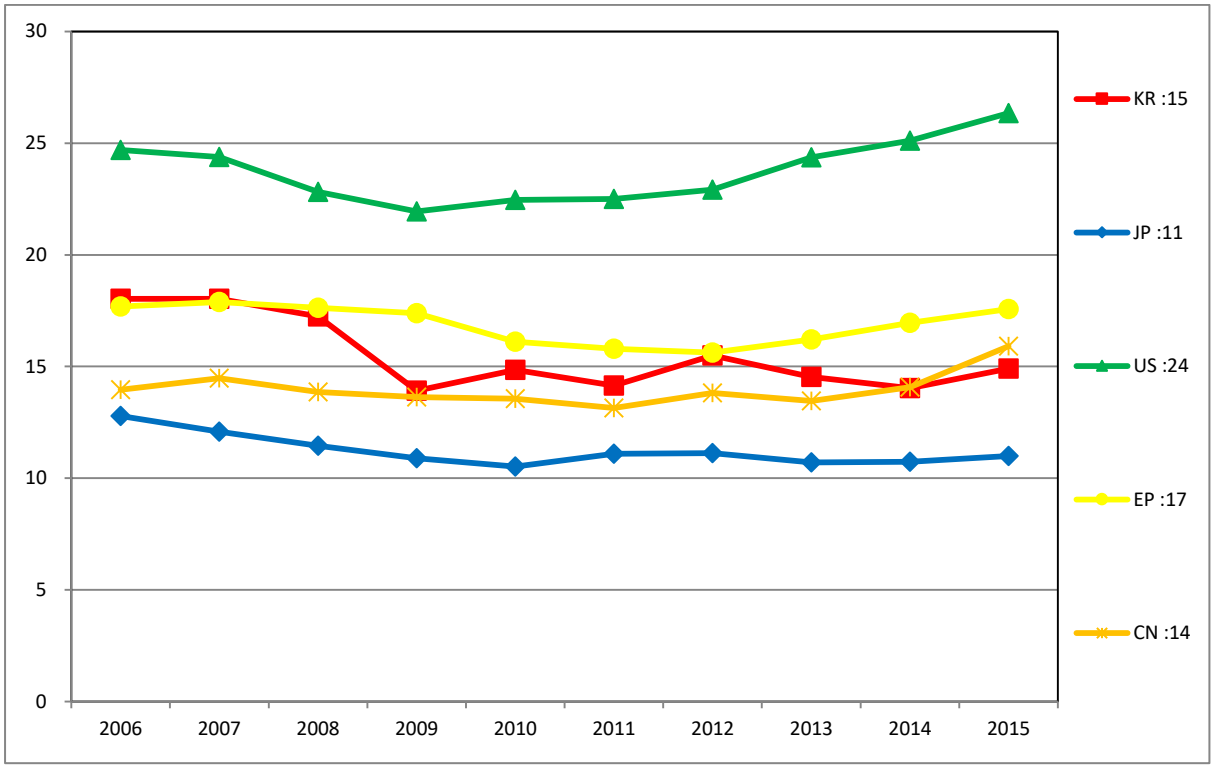

Figure 7. The average number of claimed inventions in an application

The ratio of X- or Y-marked documents in the ISR has been higher in a descending order of CN(average 19% during the period), JP(〃 16% 〃), KR(〃 14% 〃), US(〃 14% 〃) and EP(〃 12% 〃). An ISR has been produced by the ISA, as which most IP5 patent offices may function. The capability of each ISA may mean how easily the ISA can find X- or Y-marked documents during prior art searching procedure. A capable ISA can comparatively have high ratio of X- or Y-marked documents in its own ISR. Finding the capability of IP5 patent offices as ISAs is beyond research scope of this thesis, and

therefore thesis assumes that each ISA is equally capable of searching prior art.

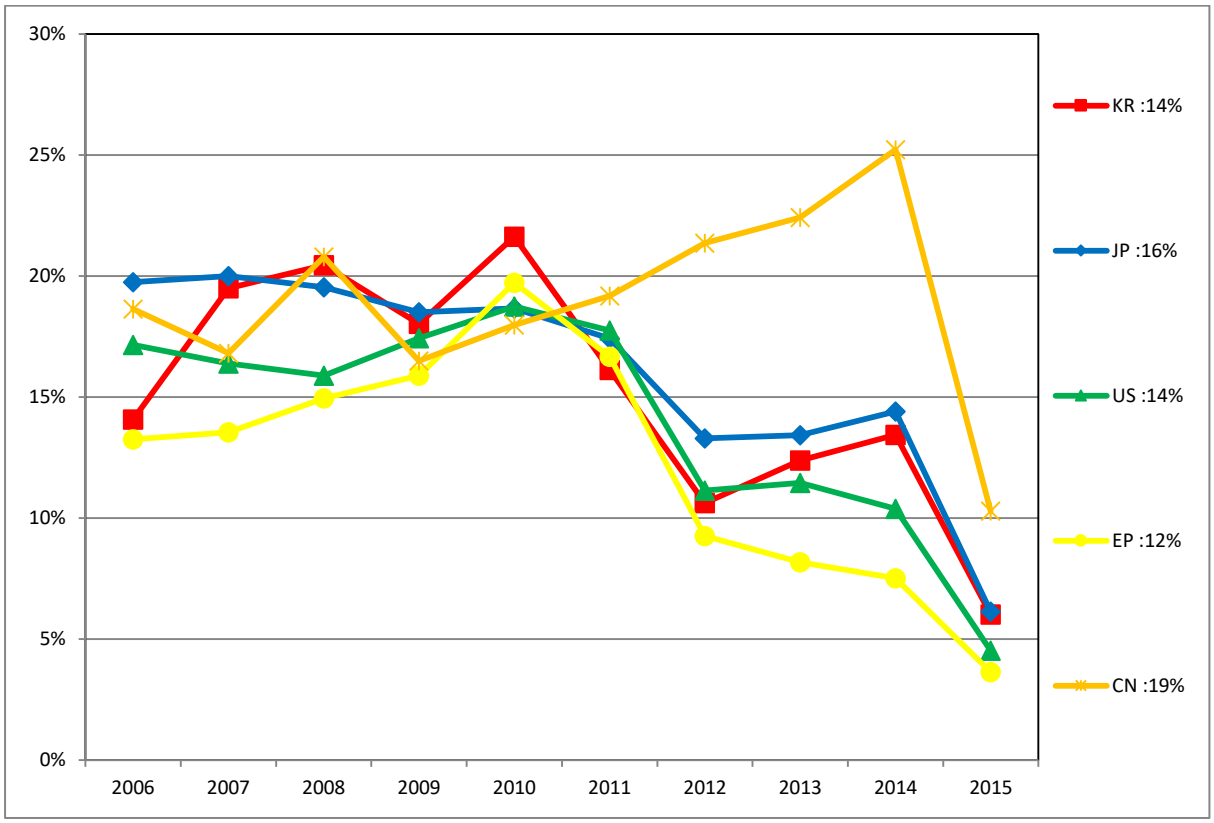

Figure 8. The ratio of X- or Y-marked documents in the Int'l Search Report(ISR)

The number of exclusive rights established on the patents has been led by IP5 countries in a descending order of US(average 6 every year during the period), JP(〃5〃), EP(〃4〃), KR(〃3〃) and CN(〃1〃). The number of non-exclusive rights established on the patents has been led by IP5 countries in a descending order of EP(average 7 every year during the period), US(〃6〃),

JP(〃 5 〃), KR(〃 2 〃) and CN(〃 1 〃). The number of pledge rights established on the patents has been mostly led by US(average 53 every year during the period) and EP(〃 41 〃). In sum, EP, US and JP have versatile usefulness in their patents.

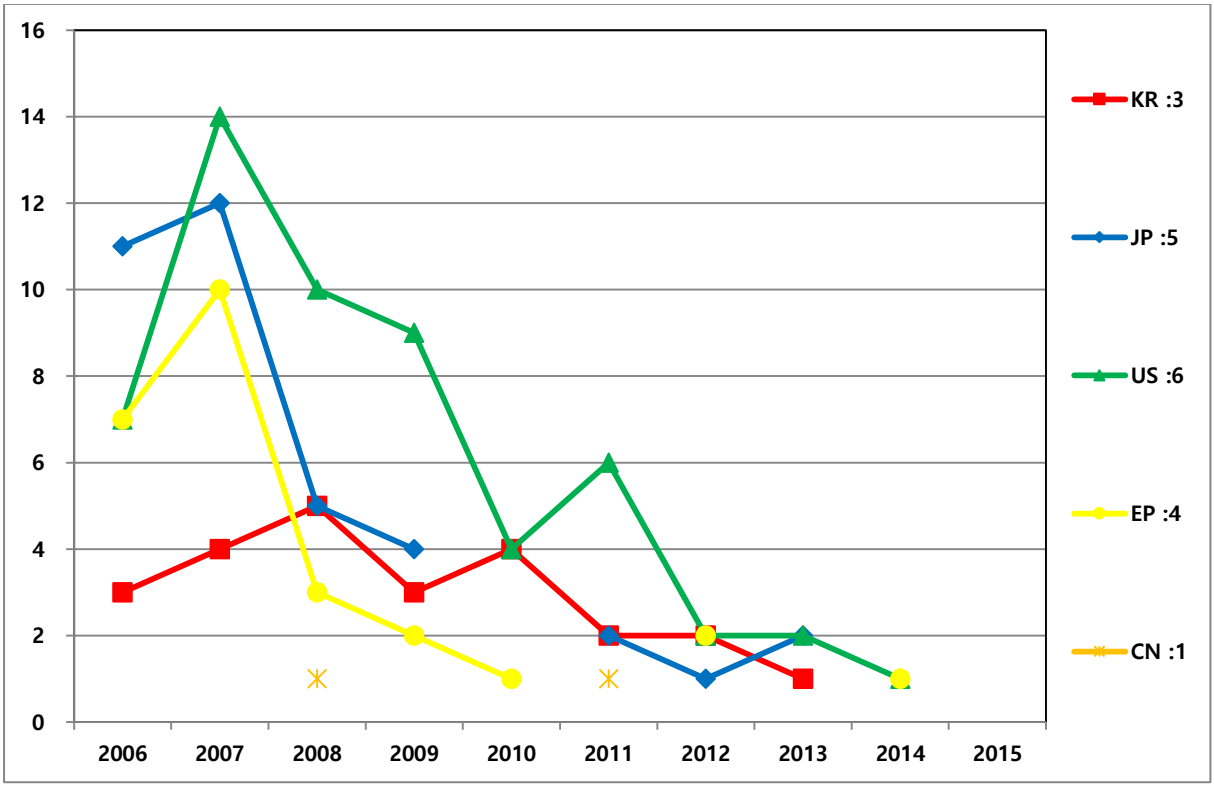

Figure 9. The number of exclusive rights established on the patents

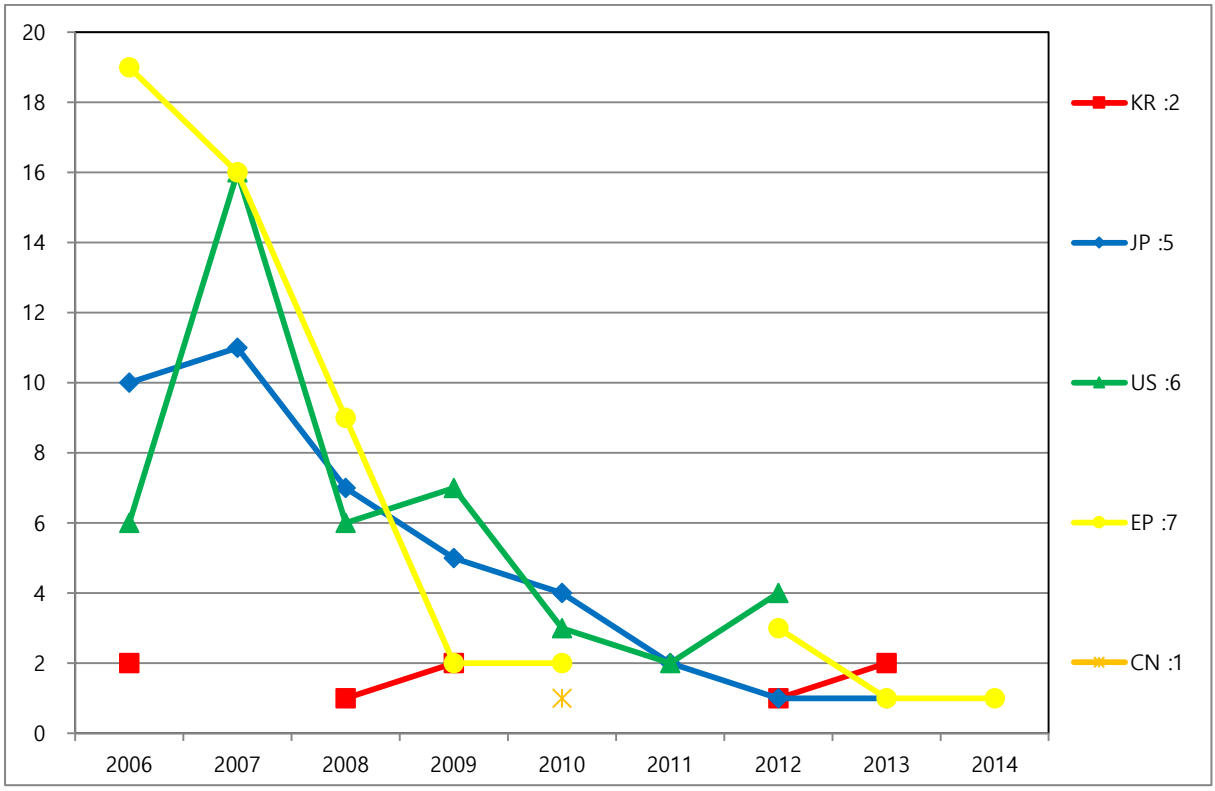

Figure 10. The number of non-exclusive rights established on the patents

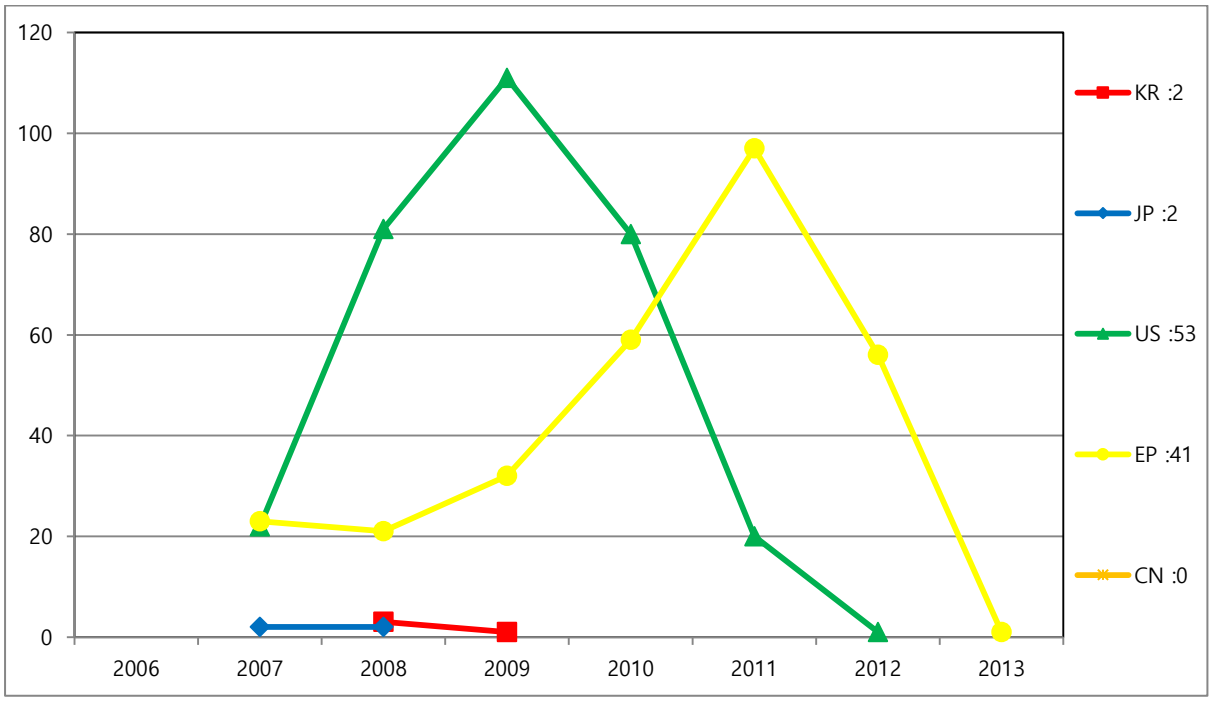

Figure 11. The number of pledge rights established on the patents

The number of the requests for patent invalidation has been mostly small – less than 10 every year. Even though it has been bigger in a descending order of JP(average 10 every year during the period), EP(〃 7 〃), US(〃 7 〃), KR(〃 2 〃) and CN(〃 2 〃), the ratio of patent invalidation upon third parties' respective requests has been bigger in a descending order of KR(average 75% every year during the period), CN(〃 42% 〃), US(〃 29% 〃), JP(〃 27% 〃) and EP(〃 21% 〃).

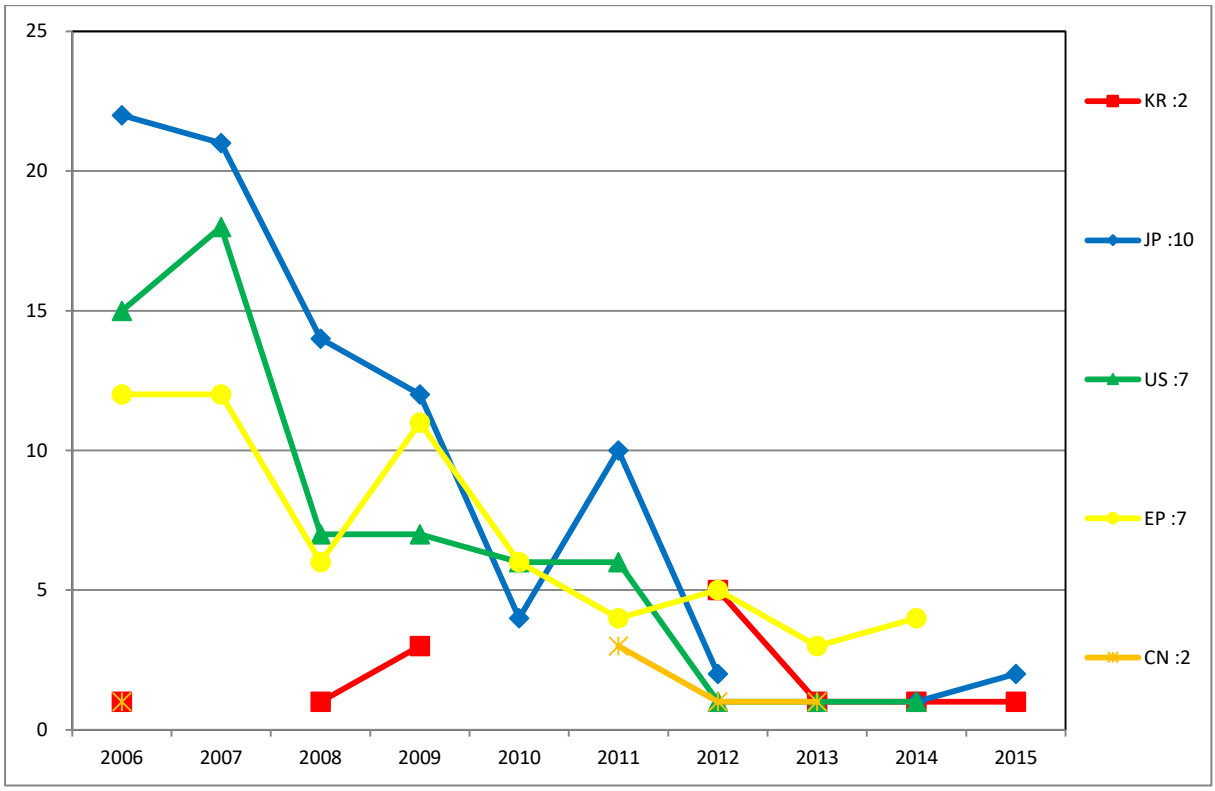

Figure 12. The number of the requests for patent invalidation

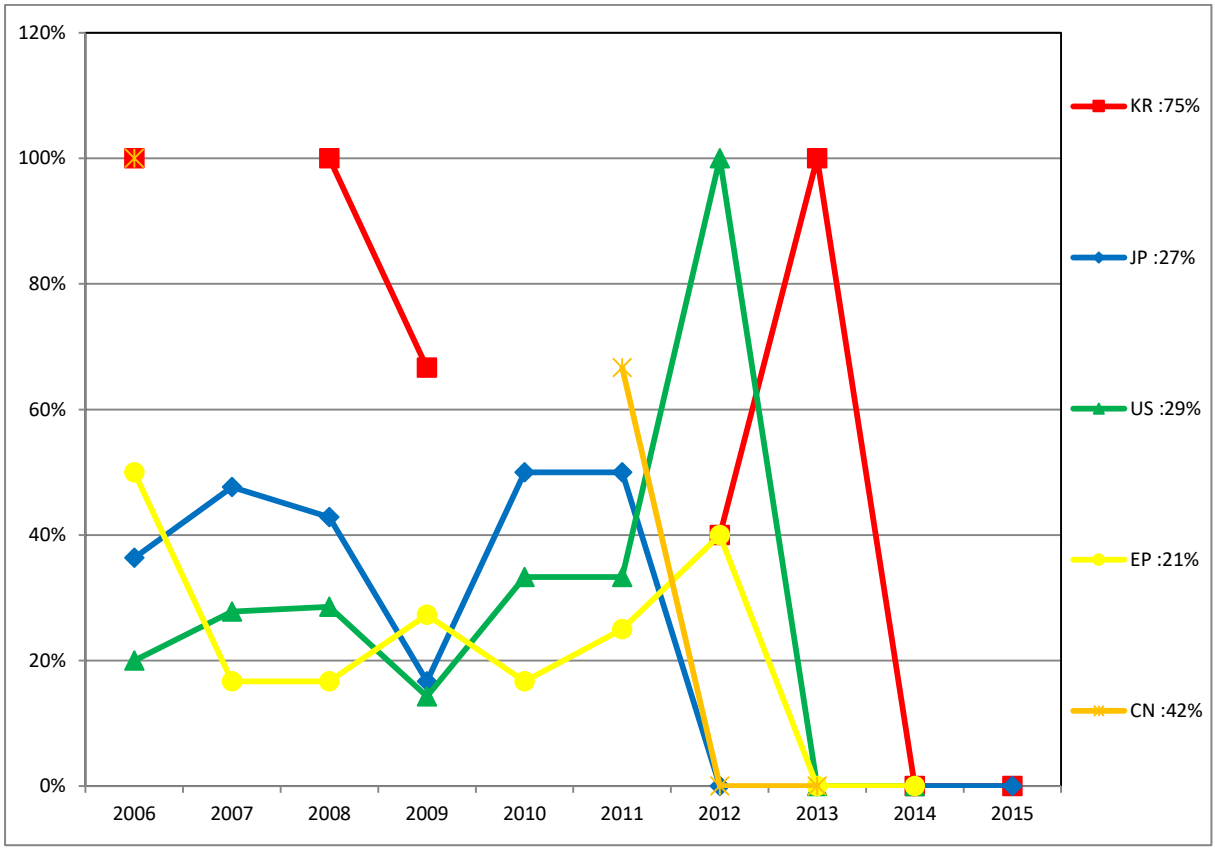

Figure 13. The ratio of patent invalidation

2. The reason for excluding some factors for the analysis

The economic value of a patented invention is related with distinguishing precious invention from non-precious one based on the contents of each patented technology. So it is very difficult to estimate the economic value of a patent without reviewing and analyzing the contents of each patented technology from a patent expert's perspective. Moreover, it is too burdensome to estimate the economic values of 309,445 PCT patent applications one by one.

So each economic value of patented invention is not considered in this thesis.

Regarding the scope of a patent right, the minimum number of components of each claimed invention is impossible to come by from the authorities, as the authorities say they do not monitor or manage the number electronically.

Then the only way left is just to count the minimum number of each independent claimed invention from 309,445 PCT patent applications. So, this thesis does not consider the minimum number of components of each claimed invention.

The volume of the specification (or the number of pages of the specification) tends to represent the complexity of a patent rather than the quality of a patent. It may indicate the quality of a patent to some degree, but it is still much of a quantity factor. So this thesis does not consider the volume of the specification for analyzing the quality of a patent.

Regarding potential social utility and commercial success, they are very important plus(+) factors for admitting high quality of a patent. However it is such a complicated and time-consuming job to identify each patent from its respective commercial product, even with the support of patent experts having various technological backgrounds that this thesis does not deal with potential social utility and commercial success.

Regarding a patent family size and the number of technological documents cited in the specification, the patent authorities do not administer statistical data

of them. Even though they are very useful information for measuring the quality of a patent, this thesis does not include them in the analysis.

Regarding the ratio of patent infringement, it is found out that the number of the patent infringement trial cases is negligibly small during the period (from 2006 to 2015). So this thesis does not consider the ratio of patent infringement for the quality of a patent.

3. The findings of the analysis

The analysis table is listed below by IP5 countries.

Table 2. The summary of the analysis

	Factors	Sequence of priority	Rem.
1	Patent grant ratio	KR, CN, JP, US, EP	+ factor
2	Patent abandonment ratio	JP, US, CN, EP, KR	- factor
3	The number of claimed inventions in a patent application	US, EP, KR, CN, JP	+ factor
4	The ratio of X-marked or Y-marked documents in the ISR	CN, JP, KR, US, EP	- factor
5	The number of exclusive rights, non-exclusive rights and pledge rights established on the patents	US, EP, JP, KR, CN	+ factor
6	The ratio of patent invalidation	KR, CN, US, JP, EP	- factor

KR has maintained △a high patent grant ratio, △a low patent abandonment ratio, △a medium number of claimed inventions in a patent application, △a medium retrieval quality (a medium ratio of X- or Y-marked documents in the ISRs), △a little small number of exclusive rights, non-exclusive rights and pledge rights established on the patents, and △a high ratio of patent invalidation.

US has maintained △a little low patent grant ratio, △a little high patent abandonment ratio, △a big number of claimed inventions in a patent application, △a little high retrieval quality (a little low ratio of X- or Y-marked documents in the ISRs), △a big number of exclusive rights, non-exclusive rights and pledge rights established on the patents, and △a medium ratio of patent invalidation.

EP has maintained △a low patent grant ratio, △a little low patent abandonment ratio, △a little big number of claimed inventions in a patent applications, △a high retrieval quality (a low ratio of X- or Y-marked documents in the ISRs), △a little big number of exclusive rights, non-exclusive rights and pledge rights established on the patents, and △a low ratio of patent invalidation.

JP has maintained △a medium patent grant ratio, △a high patent abandonment ratio, △a small number of claimed inventions in a patent application, △a little low retrieval quality (a little high ratio of X- or Y-marked

documents in the ISRs), △a medium number of exclusive rights, non-exclusive rights and pledge rights established on the patents, and △a little low ratio of patent invalidation.

CN has maintained △a little high patent grant ratio, △a medium patent abandonment ratio, △a little small number of claimed inventions in a patent application, △a low retrieval quality (a high ratio of X- or Y-marked documents in the ISRs), △a small number of exclusive rights, non-exclusive rights and pledge rights established on the patents, and △a medium ratio of patent invalidation.

Even though all the six factors importantly influence the quality of a patent, the number of exclusive rights, non-exclusive rights and pledge rights established on the patents, and the ratio of patent invalidation should not be strongly influential in this case, considering the relatively small volume of all the statistical data. The number of claimed inventions in a patent application is not so comparatively related with the quality of a patent. Moreover, even though the ratio of X- or Y-marked documents in the ISRs is high, there still can be a lot of ways of avoiding a patent rejection, such as by amending the patent claims.

From what we have seen in the above, a patent grant ratio and a patent abandonment ratio are the most strongly influential factors for the quality of a patent.

On the assumption that all the IP5 patent offices have equal capabilities in producing the ISRs as ISAs at an international phase, and in the patent examination at a national phase as well, a patent grant ratio, a retrieval quality, and the ratio of patent invalidation can be good factors for comparing the qualities of patents from IP5 countries.

Chapter Ⅴ – Conclusion

This thesis has demonstrated that it is possible to compare the qualities of patents filed by IP5 countries, by using various factors. However it will take times to make an accurate verification about the qualities of patents after the issuance of the patents.

It is also explained that it is very meaningful to try to measure the qualities of PCT patents of IP5 countries on the same field as the PCT even with limited amounts of information available.

This thesis has drawn out two influential factors for the quality of a patent for this case - a patent grant ratio and a patent abandonment ratio on the condition that all the IP5 patent offices have equal level of capabilities in producing the ISRs as ISAs at an international phase, and in the patent examination at a national phase as well. If IP5 patent offices have different levels of examination capabilities as ISAs one another, then the result can be different from the above we have already seen until now.

To sum up the preceding discussions, the analysis shows that KR seems to have the highest quality of patents among IP5 countries. However, it can be certainly said that the result is partly owing to the fact that some factors are excluded from the analysis due to the lack of cases in point and the limitation of gathering information, and also that it is assumed that IP5 patent offices has the

same or similar prior art searching capabilities one another as ISAs with regard to considering a factor “the ratio of X- or Y-marked documents in the ISR”. Likewise, it is also too quick to say that CN has the lowest quality of patents among IP5 countries, even though the analysis indicates that it seems to do so. Still, it can be cautiously said that the difference of the qualities of patents among IP5 countries has been narrowed, as a result of diversified international cooperation.

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